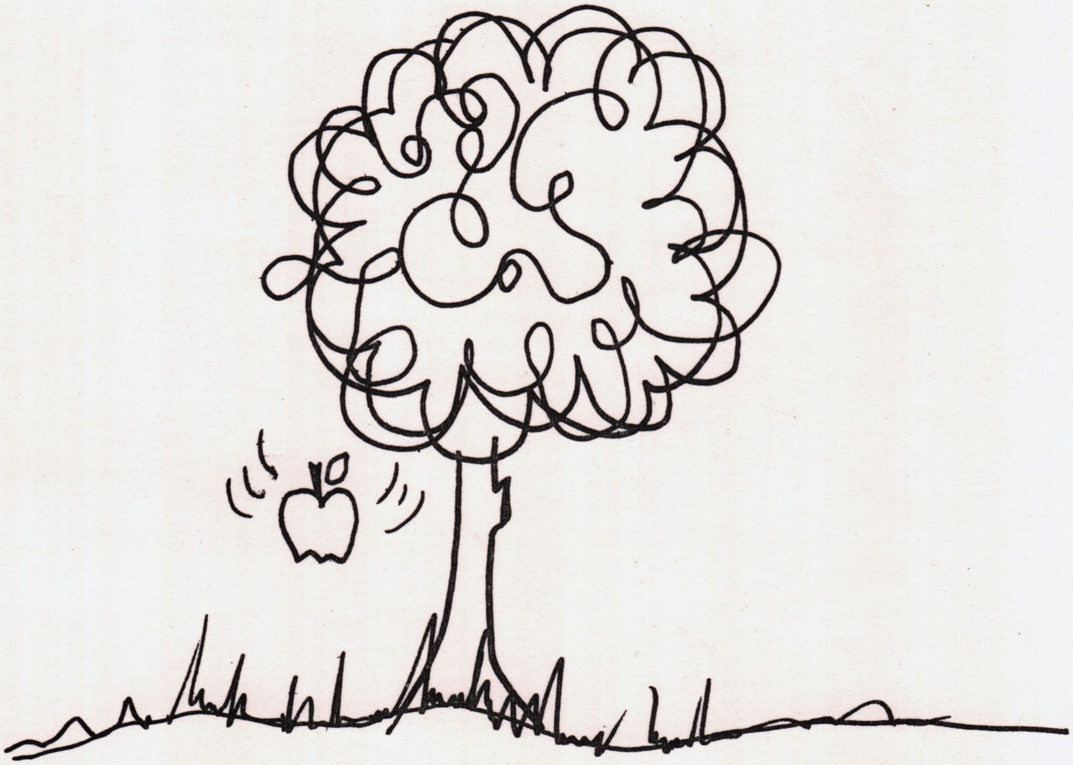
DIGITAL EQUIPMENT CORPORATION

education

EduSystems **AND PHYSICS**



computers are for kids — digital — EduSystems—expandable, economical

WHAT'S HAPPENING IN PHYSICS?

The computer as an instructional tool has traditionally found a home in the mathematics curriculum of secondary schools and colleges. Every day we are seeing expansion of computer usage to other applications. Like physics.

Problem Solving

Some schools are using EduSystems for problem solving in physics. EduSystems eliminate the tedious calculations that normally accompany such rigorous course work as we find in physics. In freeing the student from the "chore" of problem solving, the door is opened for further investigation to physical processes, without restriction to mathematical manipulations. And isn't physics really a study of natural phenomena and processes rather than a test of mathematical accuracy?

Take Valparaiso University, for example. Here, The Calculus was totally eliminated from the elementary physics course. And in its place, Digital's FOCAL computer language (FOrmula CALculator) was used. The programming training was imbedded in the course. Professor Donald Shirer found that this change served as a tremendous motivating force to students. And as a result, students began to perform detailed analysis of course work. Where the traditional curriculum often failed, the use of the computer in problem solving provided more thorough understanding of physics concepts.

Valparaiso isn't alone. Len Feingold at the University of Colorado, Milton Hoehn at Santa Rosa Junior College, Bruce Thomas at Carleton College, John Karl at Wisconsin State and Samuel Elder at the U.S. Naval Academy are just five of scores of other colleges using DEC educational computer systems every day in physics courses.

Simulations

At both the college and high school level, EduSystems are being used for simulations, programs which let the student learn by doing. Simulations are used to imitate natural processes, physical phenomena or laboratory experiments that would be difficult to reproduce under normal circumstances. They give the student the opportunity to experience physical phenomena that would otherwise be impossible, be it too time-consuming, dangerous, or simply beyond the realm of normal experience. Like x-ray diffraction, photoelectric emission, satellite orbits, radioactive decay, or landing a lunar module on the moon. Simulations put the student right in the heart of a process; concepts come alive! Simulations permit the vivid learning of concepts previously impossible to teach at all. EduSystems come complete with a set of physics simulation programs, some of which are listed in the publication description in the next section. Some of the many schools making extensive use of simulations include Berkeley High School, California, Aurora High School, Colorado, Lexington High School, Massachusetts, Golden Valley High School, Minnesota, Glen Rock High School, New Jersey, Walt Whitman High School, New York, and Cuyahoga Community College, Ohio.

A good example of a combined approach in problem solving and simulations for secondary schools is PROJECT SOLO at the University of Pittsburgh. One part of this project includes the development of learning "modules" by high school students for use by teachers and by fellow students. Some of the topics included in these modules are:

* METRIC SYSTEM
* VECTORS, BILLIARD SIMULATION
* NEWTON'S LAWS OF MOTION
* CIRCULAR MOTION
* KEPLER'S LAWS, ORBITAL MECHANICS
* OPTICS
* WAVE MOTION
* MECHANICAL ENERGY
* CONSERVATION OF MOMENTUM
* CONSERVATION OF MASS-ENERGY
* STATIC ELECTRICITY
* KIRCHOFF'S LAWS
* KINETIC THEORY - HEAT
* PARTICLE PHYSICS
* ELECTRONICS
* ELECTRICITY AND MAGNETISM

Publications

The projects and the applications for instructional computer use in physics grow every day. And with that growth, an increasing number of publications for use in the physics classroom. The following are a few examples of the literature that is available:

1. BASIC Simulation Programs, Volume IV, Huntington Computer Project and Digital Equipment Corporation, 1971, 122 pages.

This book contains curriculum programs in physics. Twenty-one program listings and guides to classroom use are incorporated in the text. For example, programs which demonstrate the effects of changing velocity on orbital motion, solve lens problems, and study kinematics. The following is a sample of available physics simulation programs:

Name	Description
BFIELD	A plot routine illustrating the B field about one and two wire currents. (Electricity and Magnetism)
BOHR	Hydrogen line spectrum and energy level diagrams are displayed. (Atomic and Nuclear)
CALORI	Calorimetry experiment to determine the heat energy to be supplied (or removed) from each mass to obtain the equilibrium temperature. (Mechanics)
DECAY1	Radioactive decay is treated qualitatively in a game-type situation.
DECAY2	Calculates half-life, mass and prints a table showing mass or number of particles of a radioactive sample.
KINERV	Review of kinematics: presents questions concerning the movement of a ball in flight. (Mechanics)
NEWTN2	A problematic situation requiring repeated application of Newton's second law. (Mechanics)
PHOTON	How energy levels are determined from the emissions of excited atoms. (Atomic and Nuclear)
PLANK	A photoelectric simulation. Students adjust the retarding potential to determine the wavelength of randomly selected electron emitting X-rays. (Atomic and Nuclear)
SLITS	A plot routine permitting further exploration of Young's Double-Slit experiment. (Light and Waves)

Name	Description
SNELL	A plot routine to aid in visualizing Snell's law. (Light and Waves)
VLOCTY	Demonstrates that average velocity ($\Delta D/\Delta T$) approaches a limiting value as $\Delta T \to 0$. A graph of D vs. T is plotted for an acceleration of 1 meter/sec^2. (Mechanics)

2. BASIC Application Programs (Set 2), Digital Equipment Corporation, Maynard, Massachusetts, 1971, 46 pages.

   The several physics applications programs contained in this book are designed to demonstrate how the computer can be applied in a meaningful way to various problems. The problems and the corresponding programs are for the most part, quite simple and are designed to be jumping off points for students from the high school level on up.

3. Peckham, Herbert D., Computers, BASIC, and Physics, Addison-Wesley Publishing Company, Reading, Mass., 1971, 320 pages.

   "A book designed to introduce faculty and students to the applications of the digital computer to undergraduate physics. Two parts dealing with BASIC and numerical analysis and specific application for the laboratory. The author strikes a balance between the very simple and the very advanced material and thus has ensured that the content is of significant value in the undergraduate physics curriculum."

Take a look at a PDP-8 or PDP-11 based EduSystem. Isn't it just the laboratory tool you need for your physics classes? If you want to know more, drop us a line at Education Products Group (5-2), Digital Equipment Corporation, Maynard, Massachusetts 01754.